California Hydrogen Highway Blueprint

Implementation Topic Team

Sub-team C/S.2c – Vehicle-Station Interface

Implementation Topic Team Public Hearing

August 31, 2004

CalEPA, Sacramento, CA

Sub-team C/S.2c – Vehicle-Station Interface

Scope of Work:

- Identify codes and standards required for station fuel dispenser, hose & fueling nozzle, and vehicle interface.
- Evaluate existing codes & standards
- Provide gap analysis
- Provide recommendations to hydrogen highway

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Fuels:
- Compressed hydrogen [CH2]
- Liquid hydrogen [LH2]
- Blended hydrogen/natural gas [HCNG]

Vehicles:
- Fuel cell vehicles [CH2, LH2]
- Internal combustion vehicles [CH2, LH2]
- Blend fuel buses [HCNG]

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Survey of Current Codes & Standards & New Activity

Current Activity in Hydrogen Fueling Station Codes

- National Fire Protection Assoc (NFPA)
- International Codes Council (ICC)

Current Activity in Hydrogen Fuel Standards

- Society of Automotive Engineers (SAE)
- International Standards Organization (ISO)
- CSA America
- American Society for Testing Materials (ASTM)

California Regulations

- California EPA (CalEPA)
- California Air Resources Board (CARB)

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Compressed Hydrogen Fueling

Status:

- **Current Codes & Standards surveyed**
- **Several gaps identified –** primarily fueling equipment & protocol - *work is underway to close gaps*

Potential CH2 Recommendations

- **Change ARB language on California H2 regulation 2292.7 to "not including fuel cell vehicles"**
- **Use CaFCP Guidelines until CSA & SAE codes become available**
- **Request California Weights & Measures to work with CaFCP & NIST on dispenser verification**

H2 Highway: **C&S for Compressed H2** vehicle refueling interface *(DRAFT)*

Status: 8/11/04

	Draft Standards	Applicable Released Standards		Recommendations:
		Gap Analysis Key:		
			= *Gap requiring additional supporting documents for interim*	
			= *Gap which can utilize current release C&S until update is available*	
			= *No Gap: Applicable C&S already released*	
CSA America				
CSA America HGV 4.1-	Compressed Hydrogen Dispensers			Utilize CaFCP Fueling Interface Guideline/STA until HGV Standards are
CSA America HGV 4.2-	Hoses and Hose Assemblies for Gaseous Hydrogen Vehicles and Dispensing Systems	CSA America NGV 4.2-	Hoses and Hose Assemblies for Gaseous Natural Gas Vehicles and Dispensing Systems	Components chosen must be Hydrogen compatible @ applicable pressure range
CSA America HGV 4.3-	Temperature Compensation Systems for Gaseous Hydrogen Vehicle Fueling Stations			Utilize CaFCP Fueling Interface Guideline/STA until HGV Standards are
CSA America HGV 4.4-	Breakaway Devices for Hoses Used in Compressed Hydrogen Vehicle Fueling Stations	CSA America CNG 4.4-	Breakaway Devices for Hoses Used in Compressed Natural Gas Vehicle Fueling Stations	Components chosen must be Hydrogen compatible @ applicable pressure range
CSA America HGV 4.5-	Priority and Sequencing Equipment for Gaseous Hydrogen Dispensing Systems	CSA America CNG 4.5-	Priority and Sequencing Equipment for Gaseous Natural Gas Dispensing Systems	Components chosen must be Hydrogen compatible @ applicable pressure range
CSA America HGV 4.6-	Manually Operated Valves Used in Gaseous Hydrogen Vehicle Fueling Stations	CSA America CNG 4.6-	Manually Operated Valves Used in Gaseous Natural Gas Vehicle Fueling Stations	Components chosen must be Hydrogen compatible @ applicable pressure range
CSA America HGV 4.7-	Standard for Automatic Pressure Operated Valves for Use in Gaseous Hydrogen Vehicle Fueling Stations	CSA America CNG 4.7-	Standard for Automatic Pressure Operated Valves for Use in Gaseous Natural Gas Vehicle Fueling Stations	Components chosen must be Hydrogen compatible @ applicable pressure range
CSA America HGV 4.8-	Hydrogen Gas Vehicle Fueling Station Compressor	CSA America CNG 4.8-	Natural Gas Gas Vehicle Fueling Station Compressor ***	Components chosen must be Hydrogen compatible @ applicable P & T range
CSA America HGV 2	Hydrogen Gas Vehicle Fueling Container	CSA America CNG 2	Natural Gas Gas Vehicle Fueling Container	Components chosen must be Hydrogen compatible @ applicable P & T range
CSA America PRD-# HGV	Pressure Relief Devices for Hydrogen Gas Vehicle (HGV) Fuel Containers	CSA America PRD-# CNG	Pressure Relief Devices for Natural Gas Gas Vehicle (CNG) Fuel Containers	Components chosen must be Hydrogen compatible @ applicable Temperature
CSA America FC 5/ UL 2264	Hydrogen Generators Utilizing Fuel Processing Technologies			
Society of Automotive Engineers International				
SAE J2601	Performance requirements for the communications and refueling algorithms of a automotive gaseous and liquid hydrogen dispensers			Utilize CaFCP Fueling Interface Guideline/STA until SAE Standards are Released
SAE J2579	Recommended Practice for Fuel Systems in Fuel Cell and Other Hydrogen Vehicles	SAE J2578	Recommended Practice for General Fuel Cell Vehicle Safety	

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Liquid Hydrogen Fueling

Status:

- **Current Codes & Standards surveyed**
- **Several gaps identified –** primarily fueling equipment & protocol - *work is underway to close gaps*

Potential Liquid Recommendations

- **Use Best Practice Guidelines until SAE codes become available**
- **Request California Weights & Measures to work with NIST to develop measurement of fuel fill rate and fuel percentages**

H2 Highway: C&S for **Liquid H2 vehicle** refueling interface *(DRAFT)*
Status: 8/09/04

Draft Standards		Applicable Released Standards		Recommendations:
		Gap Analysis Key:		
			= *Gap requiring additional supporting documents for interim*	
			= *Gap which can utilize current release C&S until update is available*	
			= *No Gap. Applicable C&S already released*	
CSA America				
	CSA is not currently doing work in LH2			
Society of Automotive Engineers International				
SAE J2600	LH2 Nozzle addition			Utilize BMW/GM LH2 Fueling Interface Protocol until SAE Standard Published
SAE J2601	Performance requirements for the communications and refueling algorithms of a automotive gaseous and liquid hydrogen dispensers			Utilize BMW/GM LH2 Fueling Interface Protocol until SAE Standard Published
SAE J2579	Recommended Practice for Fuel Systems in Fuel Cell and Other Hydrogen Vehicles	SAE J2578	Recommended Practice for General Fuel Cell Vehicle Safety	
SAE JXXXX	Hydrogen Quality Guideline for Automotive Applications (Standard number has not yet been issued)			Utilize released LH2 Guideline
National Fire Protection Association				
NFPA 52	Vehicular Fuel System Code 2005 (incorporates NFPA 57 as well) - CNG, LNG, LH2 0-H2			
NFPA 55	Standard for the Storage, Use and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, cylinders, Equipment and Tanks (will also incorporate NFPA 50A & 50B)	NFPA 50B	Standard for Liquified Hydrogen Systems at Consumer Sites	
		NFPA 70	National Electrical Code Handbook	
International Codes Council (do not apply to CA)				
ICC Model Building Code	Fuel Gas Code; Ch. 7 Liquid H2 Systems	ICC Model Building Code	Fuel Gas Code; Ch. 7 Liquid H2 Systems	
American Standards and Testing Methods				
ASTM D03.14	Subcommittee for C&S on hydrogen and fuel cell vehicles (ASTM WK) - Standard Test methods and guidelines for gaseous (CNG, LNG, CH2) fuels		Various released standards for H2 impurity constituents	

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Blend HCNG Fueling

Status:

- **Current Codes & Standards surveyed**
- **Several gaps identified -** *not much work is underway to close gaps*

Potential HCNG Recommendations

- **Work with SDOs and ARB to define the percentage range of hydrogen. Key SDOs are SAE and ISO TC197.**
- **Request CA Weights & Measures to develop methods to measure HCNG fuel fill rate and fuel percentages**
- **Recommend to DOE to identify SDO to craft standards for HCNG% guidelines**

H2 Highway: C&S for Hydrogen- CNG (HCNG) "Blend" vehicle refueling interface (DRAFT)

Status: 8/10/04

Draft Standards		Applicable Released Standards		Recommendations:
		Gap Analysis Key:		
			= *Gap requiring additional supporting documents for interim*	
			= *Gap which can utilize current release C&S until update is available*	
			= *No Gap: Applicable C&S already released*	
CSA America				
CSA America NGV 4.1-	Compressed Natural Gas Dispensers	CSA America NGV 4.1-	Compressed Natural Gas Dispensers	
CSA America NGV 4.2-	Hoses and Hose Assemblies for Gaseous Natural Gas Vehicles and Dispensing Systems	CSA America NGV 4.2-	Hoses and Hose Assemblies for Gaseous Natural Gas Vehicles and Dispensing Systems	Components chosen must be both H2 & CNG compatible
CSA America CNG 4.3-	Temperature Compensation Systems for Gaseous Natural Gas Vehicle Fueling Stations	CSA America CNG 4.3-	Temperature Compensation Systems for Gaseous Natural Gas Vehicle Fueling Stations	Standard should be established for the type and format of fuel
CSA America CNG 4.4-	Breakaway Devices for Hoses Used in Compressed Natural Gas Vehicle Fueling Stations	CSA America CNG 4.4-	Breakaway Devices for Hoses Used in Compressed Natural Gas Vehicle Fueling Stations	Components chosen must be both H2 & CNG compatible
CSA America CNG 4.5-	Priority and Sequencing Equipment for Gaseous Natural Gas Dispensing Systems	CSA America CNG 4.5-	Priority and Sequencing Equipment for Gaseous Natural Gas Dispensing Systems	
CSA America CNG 4.6-	Manually Operated Valves Used in Gaseous Natural Gas Vehicle Fueling Stations	CSA America CNG 4.6-	Manually Operated Valves Used in Gaseous Natural Gas Vehicle Fueling Stations	Components chosen must be both H2 & CNG compatible
CSA America CNG 4.7-	Standard for Automatic Pressure Operated Valves for Use in Gaseous Natural Gas Vehicle Fueling Stations	CSA America CNG 4.7-	Standard for Automatic Pressure Operated Valves for Use in Gaseous Natural Gas Vehicle Fueling Stations	Components chosen must be both H2 & CNG compatible
CSA America CNG 4.8-	Natural Gas Gas Vehicle Fueling Station Compressor	CSA America CNG 4.8-	Natural Gas Gas Vehicle Fueling Station Compressor	Components chosen must be both H2 & CNG compatible
CSA America CNG 2	Natural Gas Gas Vehicle Fueling Container	CSA America CNG 2	Natural Gas Gas Vehicle Fueling Container	Components chosen must be both H2 & CNG compatible
CSA America PRD-V CNG	Pressure Relief Devices for Natural Gas Gas Vehicle (CNG) Fuel Containers	CSA America PRD-V CNG	Pressure Relief Devices for Natural Gas Gas Vehicle (CNG) Fuel Containers	Components chosen must be both H2 & CNG compatible
CSA America FC 9 UL 2264	Natural Gas Generators Utilizing Fuel Processing Technologies	CSA America FC 9 UL 2264	Natural Gas Generators Utilizing Fuel Processing Technologies	Components chosen must be both H2 & CNG compatible
				CSA to provide a recommended nozzle geometry
CSA America PRD-V CNG	Pressure Relief Devices for Natural Gas Gas Vehicle (CNG) Fuel Containers	CSA America PRD-V CNG	Pressure Relief Devices for Natural Gas Gas Vehicle (CNG) Fuel Containers	Components chosen must be both H2 & CNG compatible
Society of Automotive Engineers International				
	No Standards for HCNG fuels		No Standards for HCNG fuels	
National Fire Protection Association				
NFPA 52	Vehicular Fuel System Code 2005 (incoporates NFPA 57 as well) - CNG, LNG, LH2,CH2. Present draft considers HCNGs with < 20% H2 equivalent to NG. (need to look at 30% LH2 fuel	NFPA 50A	Standard for Gaseous Hydrogen Systems at Consumer Sites	NFPA 52 should be updated to include HCNG blend fuels above the percentage for natural gas

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Summary

- California does not have a complete package of Codes & Standards available for dispensing CH2, LH2 and HCNG fuels
- California authorities could fill gaps for CH2 dispensing with CaFCP Guidelines until SAE & CSA codes and standards are available
- California authorities could fill gaps for LH2 dispensing with BMW/GM best practice guidelines until SAE codes and standards are available
- California authorities needs to define the range of hydrogen content to be used in HCNG blends before codes & standards can be established